

A SIMPLE AND INEXPENSIVE METHOD OF LOCALISING WITH X-RAYS.

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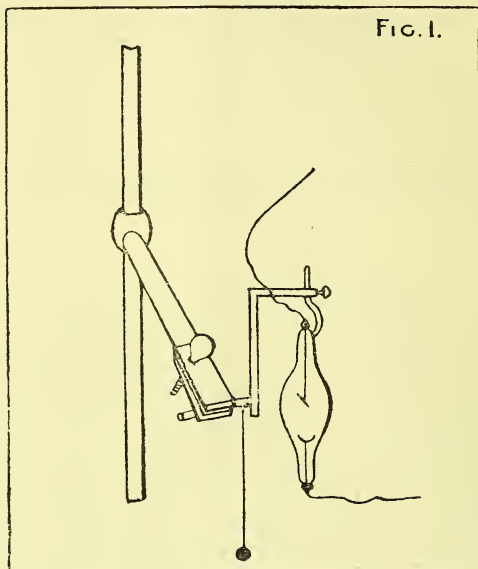
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A NUMBER of workers have devised methods of localising buried objects which cast shadows with X-rays. Probably the best is Dr. Mackenzie Davidson's, and with it most accurate results can be obtained; but, like all the others which I have seen described, it is elaborate, cumbrous, and expensive. All the methods are based on the measurement of the distance apart at which two images are produced by rays impinging upon the object in two directions at known angles to each other. In trying to arrive at this by simply moving the focus tube in the ordinary holder to definite distances on each side of the perpendicular passing through the object, I found the great difficulty lay in the fact that the tube had to be rotated upon both its axes, in order to make the slanting surface of the anode face in the desired direction. When the tube is held in the usual manner, in a clamp, this requires so much measurement and adjustment that a large element of uncertainty is introduced. The small holder which I am about to describe overcomes this difficulty by enabling the tube to be rotated on two axes crossing at the centre of the anode, the point from which the rays proceed, and in this way avoiding any alteration of the distance of this point from the plane of the surface of the sensitive plate.

As may be seen from the diagram, Fig. 1, the holder consists of one vertical and two horizontal arms, the horizontal arms coming off at right angles, at the ends and opposite sides of the vertical. The upper horizontal arm is perforated near its extremity from above down by a hole large enough to take the neck of the tube, and is provided with a pinch screw

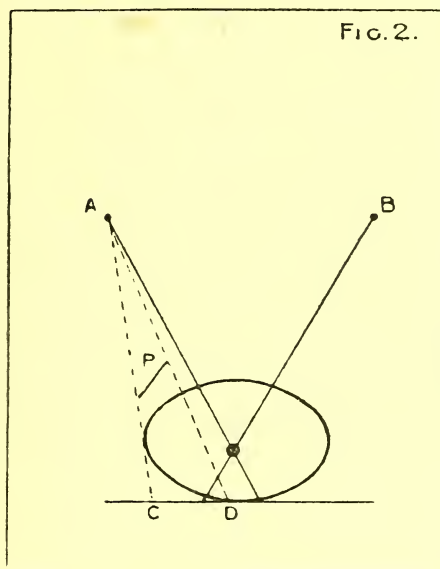
to fix it. The other horizontal arm consists of a short piece of small brass tube, open at both ends, passed through the vertical bar, and firmly fixed in it. This brass tube is held in the jaws of an ordinary wooden tube stand.



A plumb line is dropped from the brass tube.

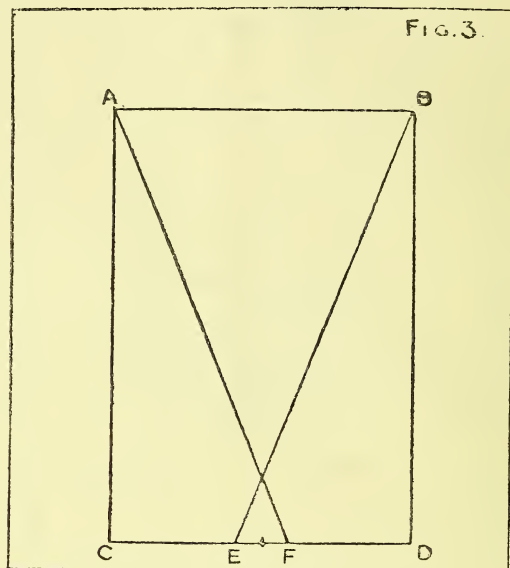
With this simple appliance [made for me by Messrs. Baird & Tatlock, Glasgow], sufficiently accurate results may be got. The method of employing it is as follows:—The neck of the tube to be used is passed through the hole in the long arm, and adjusted so that, on looking through the brass tube, the centre of the anode is found to be opposite the centre of the brass tube. The neck is then fixed by the pinch screw, and its exact position may be marked upon the stem with ink or a morsel of gummed paper. The brass tube is now clamped in the jaws of the holder, care being taken that it is horizontal. The plumb line is adjusted to the distance at which it is proposed to place the anode from the plate during the exposure, and this distance is carefully noted. The vertical position of the object having been previously approximately ascertained by the screen, or one or more photographs with an opaque object placed in known position on the surface, the tube is adjusted at whatever distance may be judged best from this

vertical position, and by rotating the tube in the hole in the upper arm, and then rotating the tube and holder in the jaws of the stand, the surface of the anode can be faced in the desired direction, without other alteration of its position. The point immediately below the plummet is now carefully marked on a sheet of paper laid below the photographic plate, and extending considerably beyond it. Upon this has previously been marked a line outside the plate, which, if prolonged, would pass directly under the object. After the first exposure is made, the tube is moved by lifting the stand until the plummet falls at the same distance on the other side of this central line. This position is also marked on the paper. The anode is adjusted, and a second exposure made. Care must be taken that the positions of the horizontal arm of the stand at the times of exposure are parallel to each other. With a little practice it is now possible to place a flat piece of metal in such a position that the portion of the plate to receive the one exposure is protected from the rays during the other. This may be seen from Fig. 2. When the



anode is in the position *A*, the surface between the dotted lines *CD* is protected by the plate *P*, and upon this portion of the sensitive film will fall the image when the anode is placed at *B*.

The metal plate, being adjusted on the other side, protects the image already made during the second exposure from *B*. After the plate is developed, a sheet of paper is taken. Upon it is drawn a parallelogram, of which the sides, *AC*, *BD*, are exactly



the length of the plumb line—that is to say, the distance of the anode from the sensitive plate — and the top and bottom, *AB*, *CD*, the length through which the tube was moved, as recorded by the marks showing the position of the plummet. The distance of the two images from each other is carefully measured and marked on the centre of the base line, *E* and *F*, and a line drawn to each of these points from the opposite angle of the parallelogram. The point where the two diagonals intersect is at the same distance from the line, *CD*, as the object was from the sensitive film.



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